APPARATUS AND METHOD FOR LOCATING DEVICES USING AN ACOUSTIC GYROSCOPE

TECHNICAL FIELD

This invention relates to wireless devices, and in particular, to determining the location of a wireless device.

BACKGROUND OF THE INVENTION

The need to accurately determine the position of a wireless device is important for the following three reasons: (1) the Federal Communication Commission Enhance 911 mandate requires all carriers to implement a technology for locating their wireless customers automatically. (2) The accurate position of a wireless telephone can be used to greatly improve wireless handoffs from one base station to another. (3) New applications and services are emerging to provide location dependent content to wireless telephones, wireless personal digital assistants (PDA), and other wireless systems. The prior art has approached the problem of determining the location of wireless devices by utilizing global positioning systems (GPS) and network-based locating methods. GPS methods use signals generated from 24 government satellites orbiting the Earth to determine the position of a mobile unit. Though accurate to a few meters, GPS signals are difficult to receive indoors and in some urban environments. Network-based methods involve triangulating the radio transmission or using RF multi-path finger printing methods to identify the most likely position of the radiating source. The multi-path method offers significant performance advantages over triangulation in urban environments.

Unfortunately, neither GPS nor network-based locating methods work well or at all, inside buildings. This is particularly true of office buildings or manufacturing plants which tend to utilize a great deal of concrete with reinforced steel. In addition, the problems of trying to perform either GPS or network-based locating methods within a multistoried building are compounded by the fact of excessive amount of multi-path emissions that are far greater than that encountered outside. It is well known that the handoffs of wireless telephones within multistoried office buildings from one base station to another base station can be greatly enhanced if the location of the wireless telephone can be accurately determined. However, because of the density of the base stations, the location information for the wireless telephone must be accurate to a few meters if it can be efficiently used in the handoff process.

SUMMARY OF THE INVENTION

This invention is directed to solving these and other problems and disadvantages of the prior art. An acoustic gyroscope within a device is utilized to accurately determine the location of the device and the acoustic gyroscope is periodically adjusted using information from external sources.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** illustrates an embodiment of a system for utilizing the invention;

FIG. **2** illustrates an embodiment of a wireless device utilizing the invention; and

FIG. **3** illustrates, in flow chart form, an embodiment of the operations performed by a wireless device in utilizing the invention.

DETAILED DESCRIPTION

FIGS. **1** and **2** illustrate embodiments of the invention. FIG. **1** illustrates an embodiment of a wireless device. Antenna **101** functions with RF circuit **102** to provide a wireless link with the wireless provider. Advantageously, the wireless provider can be a cellular system or an internal wireless system in use in a building. Processor **103** provides all of the processing necessary to carry out the standard functions of the wireless device and also, to determine the location of the wireless device based on information received from acoustic gyroscope **106**. Processor **103** is also referred to as a controller and may be any type of store program controlled device, programmed logic array device or a wired logic device. User interface **104** is the mechanism used by a user to utilize the wireless device. If the wireless device is a cellular or wireless telephone, user interface **104** will consist of the dialing keyboard, control buttons, and the headset that allows the user to talk and hear human speech. Similarly, if the wireless device is a personal digital assistant (PDA) the user interface will be that needed to perform the functions of a PDA.

In FIG. **1**, processor **103** utilizing information received from the wireless provider periodically determines the location of the wireless device utilizing such well known techniques as triangulating the radio transmission or using RF multi-path finger printing methods to identify the most likely position of the radiating source. Once the radiating sources are determined, processor **103** then determines the location of the wireless device and utilizes this location information to adjust the location information that has been determined by acoustic gyroscope **106**. Acoustic gyroscopes are well known in the art and U.S. Pat. Nos. 6,076,402, 5,780,948, 5,780,740, 5,780,739, and 5,757,103, which are hereby incorporated by reference, illustrate acoustic gyroscopes and their control.

FIG. **2** illustrates an embodiment of the invention that utilizes fixed location transmitters to perform periodic determination of the location for verifying the acoustic gyroscope calculations. Systems utilizing fixed location transmitters to determine the location of a wireless terminal are disclosed in U.S. Pat. Nos. 6,236,858, 6,195,558, 5,873,031, and 6,125,285 which are hereby incorporated by reference. The fixed location transmitters would be located at strategic locations around a building that were commonly passed by individuals on a regular basis. Such a location could well be the entrances into the building or a cafeteria or other public locations. U.S. Pat. No. 6,236,858 is particularly well suited for the determination of when people are entering or leaving exits of a building. In another embodiment, the wireless device would receive its location information from the wired communication terminal within the user's work area. In this embodiment, U.S. Pat. No. 6,125,285 is particularly well suited for this use.

FIG. **3** shows an embodiment of the invention in flowchart form. Once started, decision block **301** waits until the power is turned on. After the power is turned on, decision block **302** determines if it is possible to determine the location from an external source. The external source may well be fixed transmitters or the utilization of network-based location methods. It is possible that the wireless device is in a location where it can not determine its location from an external source. If the answer in decision block **302** is no, block **303** sets flag one and transfers control to block **307**. Flag one being set indicates that the location had not been determined or verified from an external source at the appropriate time. If the answer in decision block **302** is yes, block